

# TITANIUM

## HISTORIC REMINDER

Titanium is a low density, non-magnetic, high strength metal with excellent corrosion resistance. It has a relatively high melting point of 3000F (1650C) making it a useful material for elevated temperature applications.

In 1791 the English amateur mineralogist Gregor discovered titanium in rutile and ilmenite (iron oxide) mineral deposits. Titanium is widely distributed in the earth's crust, as the seventh most abundant metal. The metal is extracted from mineral ores using the Hunter process (1910s) and most recently the Kroll process (1940s), through a high temperature metallurgical process involving magnesium and chlorine gas.

Titanium was initially used in the 1950s by the Soviet Union for submarines, and the Americans for high performance military jets such as the Super Sabre and Lockheed A-12 (precursor to the SR-71 Blackbird). Despite costly production methods during the cold war period, titanium was considered a strategic material and stockpiled.

The drive for improved performance and fuel burn reduction of commercial aircraft such as the B777, A340, resulted in increased demand for titanium in the 1980s. Today the percentage of titanium in aircraft structure continues to grow with up to 77 tons of alloy used in the A380 engine and airframe. Titanium alloys are compatible with carbon fibre structure, also popular in modern aircraft. Manufacturing efficiencies has resulted in reduced metal cost in recent years, making the metal more popular.

Titanium is also biocompatible (non-toxic and not rejected by the human body) making it popular for surgical tools, and implants (hip and knee joints). Titanium alloys also have a stiffness which is close to that of bone, making the integration into the skeleton more successful than other metals.

Titanium and its alloys are used in forgings which can be machined to final shape, or investment cast into near net shape components.

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## TITANIUM'S CHARACTERISTICS AND CURRENT APPLICATIONS

Titanium alloy components are becoming increasingly popular and affordable, and exhibit unique properties which are sought after by many industries:

- Low density
- High mechanical strength
- Good fatigue resistance
- Excellent properties at low temperature
- Excellent properties at room and moderately high temperatures
- Excellent resistance to creeping
- Excellent resistance to marine, chemical and atmospheric corrosion
- Excellent resistance to oxidation
- Low coefficient of thermal heat transfer
- Good resistance to erosion and cavitation
- Good transmission of ultrasonic energy
- Low coefficient of thermal expansion
- Non magnetic

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